

A novel method for characterizing spacesuit mobility through metabolic cost

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Spacesuit mobility has historically been defined and characterized by a combination of range of motion and joint torque of the individual anatomical joints when performing isolated motions meant to drive that joint only in a given orthogonal plane. While this has been the standard approach for several decades, there are numerous shortcomings that suit designers and engineers would like to see rectified. First, the lack of a standardized method for collecting both range of motion and joint torque translates to many different test setups, procedures and methods of data analysis. Second, all of these previously-used methods for data collection lack some degree of repeatability, even within the same test setup and the same conductor; in addition, attempts at higher fidelity data collection techniques require high overhead and cost with minimal improvement. Lastly, isolated motions in standard anatomical planes are not representative of real-world tasks that a crewmember would be performing during an EVA, be it microgravity or surface exploration based.

To address these shortcomings, options are being explored within the Space Suit and Crew Survival Systems Branch to ascertain the feasibility of an alternative approach to defining mobility – one that is more repeatable, lower overhead, and more tied to functional EVA tasks. This paper serves to document the first attempt at such an alternative option – one that looks at the metabolic energy-cost of a spacesuit. In other words, can we objectively compare the mobility of a spacesuit by evaluating the metabolic cost of that suit to the wearer while performing a battery of functional EVA tasks?